Advanced Multispectral Infrared Microimager (AMIM) for Planetary Surface Exploration

Completed Technology Project (2016 - 2018)

Project Introduction

We propose to mature to TRL 5 the Advanced Multispectral Infrared Microimager (AMIM) – a compact microscopic imager capable of providing mineralogy of rocks and soils within a microtextural context – for future landed Discovery, New Frontiers, and Flagship missions to planetary surfaces. AMIM consists of compact, low-power multispectral LED arrays coated with narrow-bandpass filters (> 25 wavelengths with FWHM ≤ 50 nm), an adjustable focus mechanism capable of focusing from a distance of ~30 mm (spatial resolution ≤ 30 µm/pixel) to infinity with z-stacking and high depth of field, and an infrared camera capable of imaging from the visible/near-infrared to shortwave-infrared (VNIR/SWIR, nominally 0.4 to 2.6 µm). This wavelength coverage has wide applicability for the detection of minerals and ices. However, specific wavelengths and spectral range (up to 5.0 µm) can be easily tailored to address specific mission science and engineering requirements. AMIM is particularly well-suited for investigating the composition of rocks and soils in situ, especially Fe-bearing igneous and oxide minerals (ex. olivine or hematite), carbonates, OH/H_2O-bearing minerals (ex. clays or sulfates), and ices (ex. H_2O and CO_2). These minerals are of cross-cutting importance in planetary science and are indicative of geologic processes. By mapping these minerals up-close and in survey-mode, AMIM would play a critical role in characterizing the surface regolith near the lander and identify targets for sampling for further study with onboard instruments or potential return to Earth. Furthermore, data collected by AMIM would provide ground truth to globally mapped datasets collected from orbit. AMIM advances beyond the capabilities of current microscopic imagers in the visible or multispectral imagers in the VNIR (0.4-1.0 µm), which are limited to detecting Fe-bearing minerals. The expanded coverage in the SWIR and narrow bandpasses (FWHM ≤ 50 nm) enable AMIM to discriminate both iron and non-iron bearing mineralogies with greater fidelity compared to these instruments or similar imagers with wider bandpasses (> 100 nm). By employing a compact, low-mass, low-power illumination system, AMIM eliminates the need for a filter wheel, grating system, multiple detectors, or tunable filters. This reduces the mass, size, power consumption and complexity of AMIM compared to larger imaging spectrometers, enabling it to be deployed on a robotic arm on a rover/lander, or small asteroid lander such as POGO or MASCOT. Thus, AMIM would provide many of the capabilities that are associated with an orbital or rover/lander-mounted imaging spectrometer, but at a size and mass comparable to current microimagers - a capability unmatched by any current imaging instrument proposed for flight. To advance the maturity of AMIM to TRL 5, our efforts will focus on advancing the maturity of the lower-TRL components, namely the LED arrays coated with narrow-bandpass filters and the adjustable focus mechanism, and build an integrated instrument for testing under relevant environmental conditions. To achieve this, we will: 1) design, build and characterize the LED arrays coated with narrow-bandpass filters; 2) test the performance of the arrays over time and under relevant environmental conditions; 3) design, build and characterize the compact

Image Not Available

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Organizational Responsibility

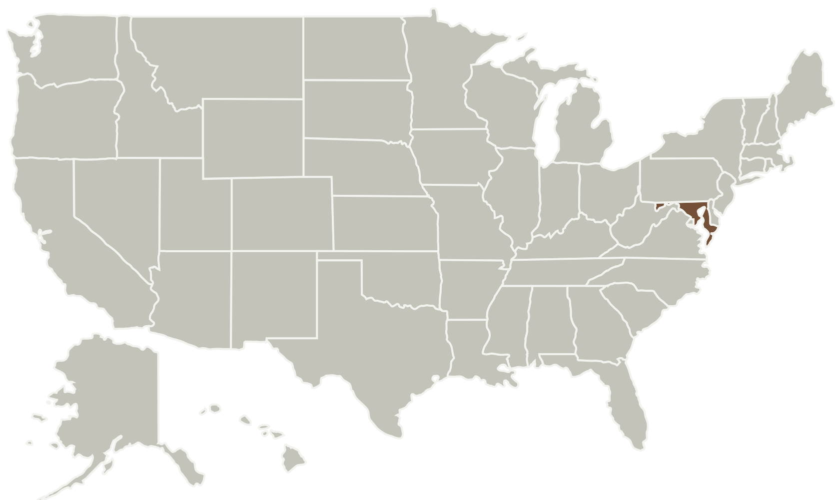
Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Planetary Instrument Concepts for the Advancement of Solar System Observations adjustable focus mechanism; 4) test the performance of the focus mechanism under relevant environmental conditions; and 5) build an integrated instrument, including the LED arrays, adjustable focus mechanism, and SWIR camera for testing with relevant geologic samples and under relevant environmental conditions. These efforts will advance the maturity of a compact, low-mass, low-power instrument that will play a key role in maximizing the scientific return from any future landed planetary science mission identified in the latest Planetary Sciences Decadal Survey (e.g. Discovery-, New Frontiers-, and Flagship-class landers/rovers).

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Johns Hopkins University	Supporting Organization	Academia	Baltimore, Maryland

Primary U.S. Work Locations
Maryland

Project Management

Program Director:

Carolyn R Mercer

Program Manager:

Haris Riris

Principal Investigator:

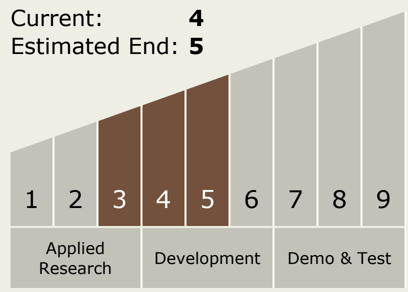
Jorge I Nunez

Co-Investigators:

Ryan Mcmichael
Scott L Murchie
Felicia Hastings
Rachel Klima

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **5**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  └ TX08.3 In-Situ Instruments and Sensors
    └ TX08.3.4 Environment Sensors

Target Destination

Others Inside the Solar System